# Correlation Between MUF and Solar Flux

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Due to the day-to-day variability of the F2 region, we have propagation predictions that are statistical over a month's time frame.

A good question to ask is "Why don't we have daily predictions?" Let's investigate this by doing a scatter plot of the daily solar flux and the daily MUF (maximum usable frequency) using ionosonde data.

The following plot uses the daily data from the Canberra (Australia) ionosonde for the month of December 1982. The MUF reported by the ionosonde assumes the ionosonde is the mid point of a 3000km path. All data is at local noon at Canberra.
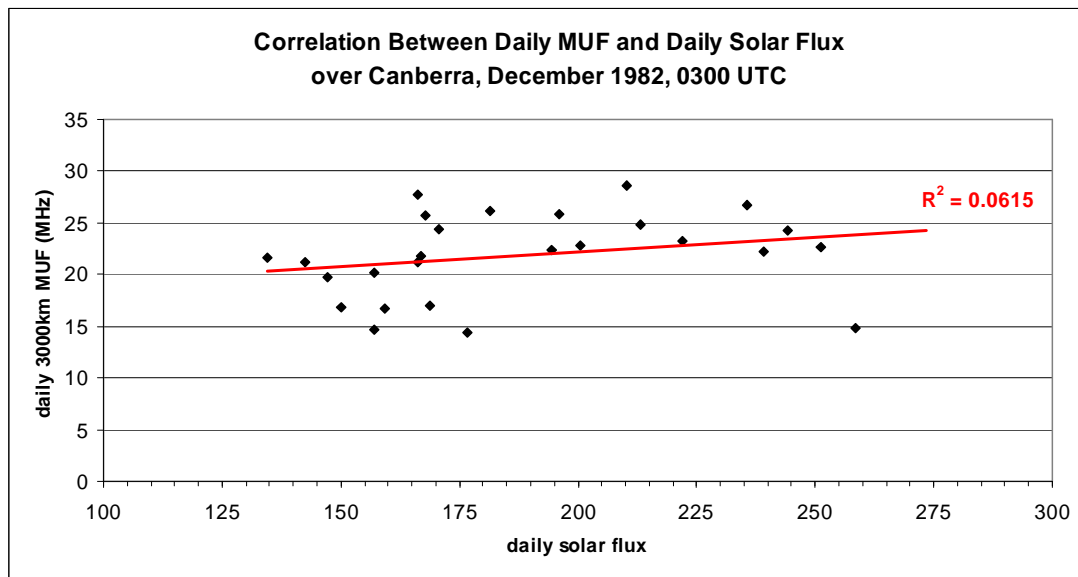

The R^2 value in the upper right corner of the plot tells us how well correlated the two parameters are.

R^2 = 1 indicates perfect correlation, and all the data points would fall right on the red best-fit trend line. R^2 = 0 indicates no correlation, and the data points would be widely scattered about the best-fit straight line.

With an R^2 of 0.0615, we conclude that the daily MUF is not well correlated with the daily solar flux. That's easy to see in the plot, too – for example, the MUF was anywhere from 17MHz to 28MHz on the six days in December 1982 that had a flux around 170.

Now let's do a scatter plot of the smoothed solar flux (calculated in the same way as the smoothed sunspot number) and the monthly median MUF (the value that has half of the month's data below it and half of the month's data above it).

Correlation Between Monthly Median MUF and Smoothed Solar Flux over Canberra, December month, 0300 UTC

$R^2 = 0.8637$
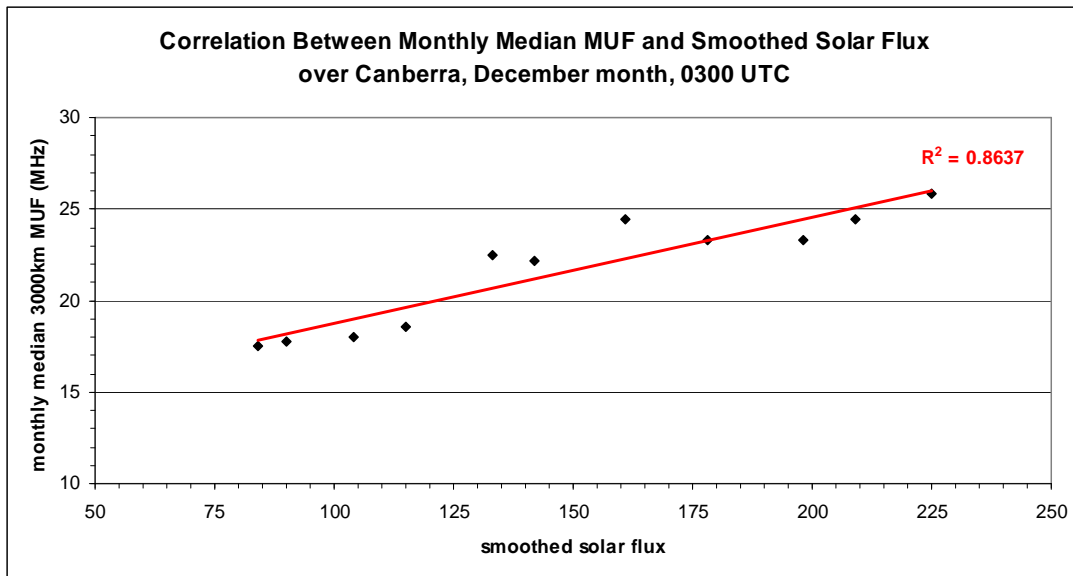
What's immediately obvious about this plot is how much closer the data points are to the red best-fit trend line as compared to the previous plot.

The R^2 value is now 0.8637, indicating a high degree of correlation. That's a significant improvement over the daily plot, and this correlation is why the developers of our propagation prediction programs used a smoothed solar index (sunspots or 10.7cm flux) in conjunction with monthly median ionospheric parameters – thus making our predictions statistical over a month's time frame. They certainly had daily data, but they realized the correlation was not too good with daily values.